(2)

AD-A262 484

MENTATION PAGE

Form Approved
OMB No 0704-0188

REPORT DATE	REPORT TYPE AND DATES COVERED
	FINAL/15 DEC 90 TO 14 DEC 92

4. TITLE AND SUBTITLE
STUDY ON VARIOUS PROBLEMS IN STATISTICAL PLANNING & INFERENCE (U)

5. FUNDING NUMBERS
2304/A5
AFOSR-91-0115

6. AUTHOR(S)
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8. PERFORMING ORGANIZATION REPORT NUMBER
AFOSR-TR- 93 0400

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
AFOSR/NM
110 DUNCAN AVE, SUTE B115
BOLLING AFB DC 20332-0001

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
AFOSR-91-0115

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
APPROVED FOR PUBLIC RELEASE: DISTRIBUTION IS UNLIMITED

12b. DISTRIBUTION CODE

13. ABSTRACT (*Maximum 200 words*)

The research done under this grant is (1) New main effect plus one plans and their robustness property against deletion of runs and (2) Robust experimental plan and its role in determining robust design against noise factors. The researcers near completion are on (1) Incorrectness of orthogonality condition for main effect plans, and (2) Determination of robust design against noise factors and in presence of signal factors.

14. SUBJECT TERMS

15. NUMBER OF PAGES
9

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	SAR

NSN 7540-01-280-5500

Standard Form 298 (Rev 2-89)
Prescribed by ANSI Std Z39-18
298-102

Final (Annual) Report

Project Title:	Study on Various Problems In Statistical Planning and Inference
Principal Investigator:	Subir Ghosh
Period:	December 1991 - December 1992
Grant No.:	AFOSR-91-0115
Program Manager:	Dr. Jon A. Sjogren Department of Mathematics and Information Sciences Air Force Office Of Scientific Research Bolling Air Force Base DC 20332-6448

Contents

Research Progress and Forecast Report

0 Summary

The research done under the Grant AFOSR-91-0115 during the period December 1991 - December 1992 are 1) New main effect plus one plans and their robustness property against deletion of runs and 2) Robust experimental plan and its role in determing robust design against noise factors. The researches near completion are on 1) Incorrectness of orthogonality condition for main effect plans, 2) Determination of robust design against noise factors and in presence of signal factors.

1 Research Done

1.1 New Main Effect plus one plans and their robustness property against deletion of runs.

(Please see the enclosed technical report.)

1.2 Robust experimental plan and its role in determining robust design against noise factors.

(Please see the enclosed technical report.)

2 Final (Annual) Report

2.1 Incorrectness of Orthogonality condition for main effect plans.

The condition of proportional frequencies stated in Addleman (1962, 1963) as a necessary and sufficient condition for orthoganlity of main effect plans in general factorial experiments. Texts like Dey (1985), Raghavarao (1971) presented the Addleman's necessary and sufficient condition. Addleman (1962, 1963) gave main effect plans satisfying the condition of proportional frequencies that he claimed to be orthogonal main effect plans. Jacroux (1992) used the Addleman's necessary and sufficient condition for finding minimal orthogonal main effect plans. In this paper, it is shown that the Addleman's condition is in fact incorrect. A correct necessary and sufficient condition for orthogonality of main effect plans is given. Using the correct condition, it is also shown the incorrectness of the claim of orthogonality in Addleman's (1962, 1963) plans and Jacroux (1992) plans. This work is particularly important because orthogonal main effect plans are widely used in the off-line quality improvement studies. The paper on this work is now in the process of writing.

2.2 Determination of Robust Design Against Noise Factors and in Presence of Signal Factors.

In this work, methods are proposed in finding the robust design in both Taguchi and Standard setups when a signal factor is present. The robust design is a set of level combinations of control factors so that the effect of controllable noise factors on response is minimum. Both univariate and multivariate methods are used in finding the influential noise factors for the determination of robust designs. The paper on this work is now in the process of writing.

3 Publications

3.1 Published

1. Ghosh, S. and Mahoney, J. (1991). Efficient nearly orthogonal deletion designs, 22 manuscript pages. Proceedings of R. C. Bose Symposium on Probability, Statistics and Design of Experiments, (Edited by Bahadur, R. R.), 299-313. Wiley Eastern, New Delhi.

2. Ghosh, S. and Duh, Y. J. (1991). Adjusting residuals in estimation of dispersion effects. Australian Journal of Statistics, 33, 1, 65-74.

3. Ghosh, S. and Duh, Y. J. "Determination of optimul experimental conditions using dispersion main effects and interactions of factors in replicated factorial experiments". *Journal of Applied Statistics*, 19, 3, 367-378, (1992).

4. Ghosh, S., Kageyama, S. and Mukherjee, R. "Efficiency of connected binary block designs when a single observation is unavailable". *Annals of Institute of Statistical Mathematics*, 44, 3, 593-603, (1992).

5. Ghosh, S. and Derderian, E. "Robust experimental plan and its role in determining robust design against noise factors", *The Statistician*, 42, 19-28 (1993).

3.2 To Appear

1. Ghosh, S. and Namini, H. "On invariance of arrays with two symbols", 14 manuscript pages A spacial issue of *Sankhya*, Proceedings of R. C. Bose memorial conference on combinatorial mathematics and applications.

2. Ghosh, S. and Talebi, H. "Main effect plans with an additional search property for 2^m factorial experiments", 27 manuscript pages. To appear in *Journal of Statistical Planning and Inference.*

3. Ghosh, S. "New main effect plus one plans and their robustness property against deletion of runs", 20 manuscript pages. To appear in *Statistical Sciences and Data Analayis*, the Third Pacific Area Statistical Conferences (K. Matusita et. al., ed.), VSP International Science Publishers, Zeist (Netherlands).

3.3 Submitted

Ghosh, S. "Sequential construction of new main effect plans with higher revealing power for 2^7 factorials", 19 manuscript pages. Journal of Combinatorics, Information and System Sciences. (Professor C. R. Rao Dedication Volume).

4 Conferences

4.1 Invited Talk

a. Presented invited talk at the First International Triennial Calcutta Symposium on Probability and Statistics, December 27, 1991 - January 1, 1992.

b. Presented invited talk at the conference in honor of Professor S. K. Mitra, Indian Statistical Institute, Calcutta, India. December 23-24, 1991.

c. Presented invited talk at the Design of Experiments Conference at the Mathematical Research Institute, Berkeley, May, 1992.

4.2 Invited for future meetings

a. International Conference on Linear Statistical Inference in Poznan, Poland, May 31-June 4, 1993.

b. Industrial Statistics and Quality Improvement, Oakland University, Michigan, August 20-22, 1993.

4.3 Contributed Talk

I presented a contributing paper at the national meetings of the Institute of Mathematical Statistics, American Statistical Association and Biometric Societies, August 9-13, Boston.

4.4 Discussant

I was a principal discussant in a special contributed paper session at the annual meetings in Boston, August 9-13.

5 Interactions:

5.1 Chairing Sessions

I chaired a contributed paper session at the annual meetings in Boston, August 9-13.

5.2 Editorship

I have joined as an associate editor of *Communications in Statisics*, Starting from Volume 22, 1992.

5.3 Students

Three Students, Edna Derderian, Walid Al-Sabah and C-L Lai are working on their Ph.D. dissertations under my direction.